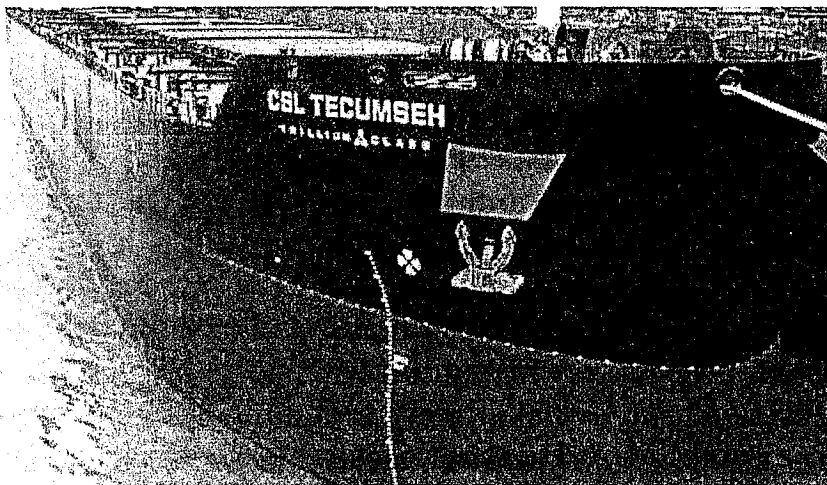


For Immediate Release
Contact:
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Port of Redwood City

New Self Unloading Ship with Latest Technology Calls at Port of Redwood City

Employing the latest leading edge technology, a new bulk ship, The CSL Tecumseh, made its maiden voyage to the Port of Redwood City on Wednesday, May 29. Named after a respected war chief of the Shawnee Indians in the early 1800s, Tecumseh brought 40,000 tons of construction aggregates from the Orca Quarry in British Columbia. The material was delivered to Cemex Aggregates, a major Port tenant. This is an essential material for ready-mix concrete plants from Santa Rosa to San Jose. The self-unloading Panamax-sized ship unloads all of its cargo of construction materials in 18-24 hours. The CSL Tecumseh is the sister ship to The Rt. Hon. Paul E. Martin (named after a former Canadian prime minister and shipping executive), which made its first voyage to the Port last November. The two ships are CSLI Trillium Class self-unloading Panamax vessels, owned and operated by CSL International, a division of The CSL Group, the world's largest owner and operator of self-unloading vessels. Featuring the most advanced technology available, these Trillium Class vessels set new standards in operational and environmental performance, energy efficiency and reliability. "Together these two ships are planning to bring millions of tons of high quality construction aggregates from British Columbia to the three ports in the San Francisco Bay Area - Port of Redwood City, Port of Richmond, and Port of San Francisco," Port

Executive Director Michael J. Giari said. "With increased construction, these materials are vital for ready-mix concrete plants in the Greater Bay Area." These ships face serious navigation restrictions at the Port of Redwood City because its authorized depth of 30 feet is down to 27 feet, which limits their transportation efficiency and increases the cost of this construction material, Giari said. Many times these ships have to wait for high tide and bring less than full loads because of the draft restrictions. Giari said that the Port is working with federal legislators to obtain maintenance dredging funds. Meanwhile, the ships are drawing raves in the maritime industry because of their environmental efficiency. Dust suppression is significantly improved on the new ship through feeder gates, boom dust enclosures, dust collectors, and a foam spray dust suppression system. The new ships meet or exceed compliance with current and anticipated environmental regulations, from reductions in NOx, Sox, and other air emissions, to fuel efficiency and waste and pollution management.



The CSL Tecumseh



An App to Help You Prove the Beach You're Standing On Is Public

EMILY BADGER MAY 29, 2013 12 COMMENTS



Decades-old California law is quite precise about who owns the state's spectacular coastline: Everything below the mean high tide line over the previous 18.6 years belongs to the public. That means, in effect, that everyone has a right to walk on wet sand, anywhere (OK, outside of the boundaries of a few military installations). "There's no such thing as an all-private beach in California," says Jenny Price, a writer, artist and environmental historian who lives on Venice Beach.

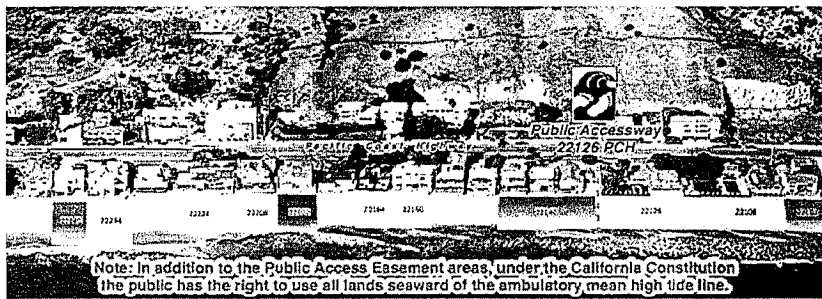
The California Coastal Act, crafted in the 1970s, has since tried to enforce that standard, protecting both the coastal environment and the public's access to it. But by the time the act was passed, two-thirds of the state's shore was already walled off behind private development, with locked gates between homes sealing off access to the wet sand beyond. In tony Malibu, just west of Los Angeles, 20 miles of the 27-mile coast are lined like this with what Price calls a "fortress" of private development – much of it plastered with disingenuous signs projecting the impression of a thoroughly private beach.

Ideally, the state standard says the public should have an access point down to the water every thousand feet along the coast. In reality, in Malibu, there is a scattering of hard-to-find gateways (17 in all), with "no parking signs" in front of them and an invisible patchwork behind them of easements where you can legally lay down your beach towel.

"For 40 years now, the public has been granting development permits in exchange for dry sand," Price says. "And for 40 years, the public hasn't even known that they've been doing that."

This could be about to change, and likely in a way that will miff Malibu homeowners who have for decades gone to some pretty impressive lengths to confuse the public about its right to access some of the state's most important public space. Price, working with a Los Angeles-based startup called Escape Apps, has been walking the beach and tracing the little-used easements maps created by the California Coastal Commission.

L.A. is a place where people who are affluent expect to have a fair degree of protection from the public.



Public Accessway to Shore

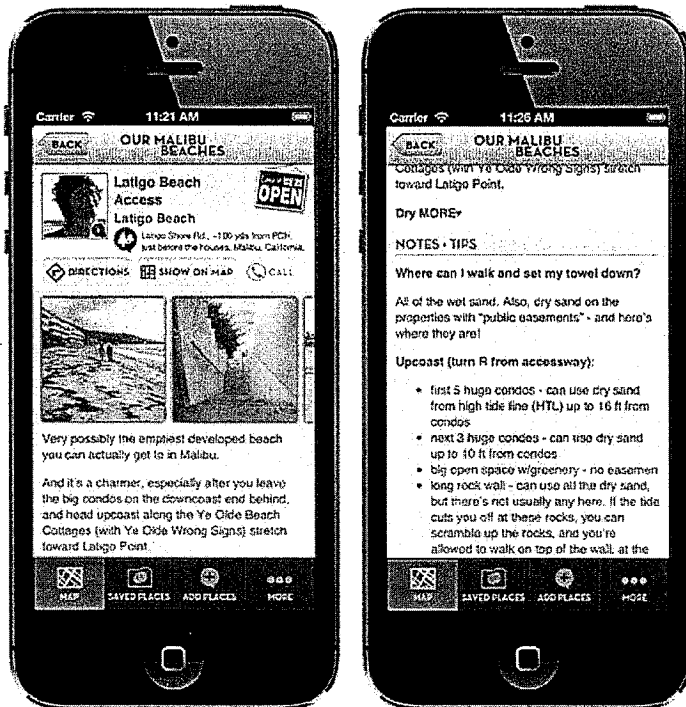
Easement extending from Mean High Tide Line inland to structure, with a 10 ft. privacy buffer from structure
 Easement extending from Mean High Tide Line inland 25 ft., and no closer than 5 ft. from structure
 Easement extending from Mean High Tide Line inland 50 ft.
 Easement extending from Mean High Tide Line inland 25 ft.

Waterline to structure

Easement extending from Mean High Tide Line inland to structure
 Easement extending from Daily High Water Line inland 25 ft., and no closer than 10 ft. from structure
 Easement extending from Mean High Tide Line inland 25 ft., with a 10 ft. privacy buffer from structure

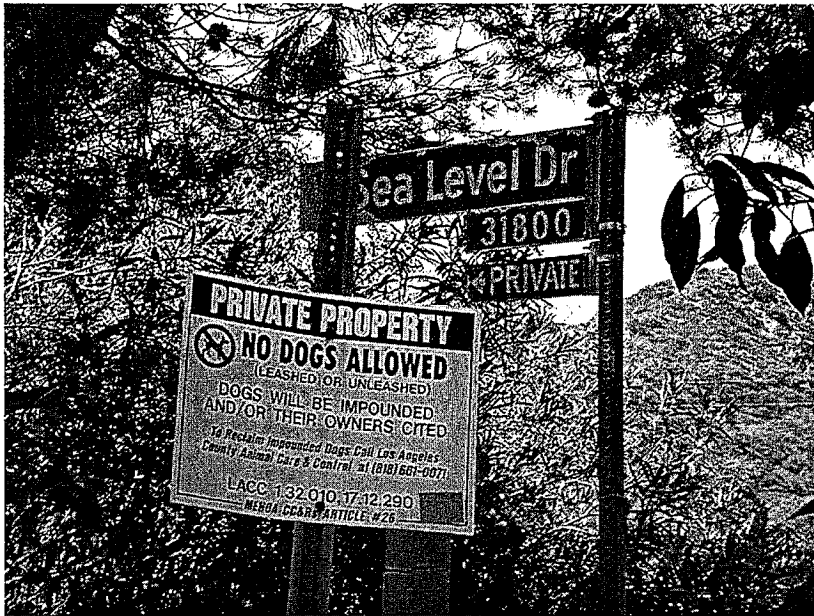
A California Coastal Commission map of Carbon Beach showing public shoreline access and easements on private land.

This summer, Price and Escape Apps are planning to release a smartphone app that will explain to anyone who cares to download what all of the signs on Malibu won't tell you: where you can legally go to the beach. Today, they're entering the last stretch of a Kickstarter campaign to develop the app for Android as well, while making it free for the summer.



Our Malibu Beaches

On the ground, the Malibu coast looks more like this:



All photos by Jenny Price

That last sign shows an official public access point to Lechuza Beach, at left, immediately next to what looks like a contradictory sign posted by a property owner. This strategy is actually the second line of defense. The first one comes in the form of official-looking orange cones and "no parking" signs – available at any home improvement store – that discourage people from ever even getting out of their cars.

"Making it difficult to park is actually a strategy that lot of affluent beach communities have used all over the country," Price says. Get any of these signs removed off of the Pacific Coast Highway, and they pop back up in a few months, Price says. "It's like whack-a-mole."

It's impossible to make a public space truly public if the public doesn't know they can go there.

"Then we also have fake driveways and fake garage doors," she says. Seriously. "I've seen one property that has four garage entrances, and all of those have cut curbs. But if you look really, really closely, three of those garages are sealed. There's no garage there."

Price, who knows her way around these beaches better than anyone, has been photographed "trespassing" by property owners while leading tours to the beach. She's been contacted by their lawyers. She's been told where she can't park on these grounds: "This is my house, this is my sidewalk."

All of which prompts the question: Do these homeowners actually believe the public has no right here, or are they intentionally trying to misdirect people? The homeowners who have granted easements in exchange for permits to expand their homes or develop their properties (many of whom have tried after the fact to contest the easements) certainly can't claim the first excuse.

"I think most of what's going on is they don't think the public should be there because they've paid so much money for their houses, and L.A. is a place where people who are affluent expect to have a fair degree of protection from the public. It's not New York, it's not Chicago," Price says. "There are people who have mansions 50 feet from the high tide line, and they think the environmental problem down there is that a few more people will walk in front of their mansions."

At the heart of the problem, she says, is a fundamental lack of understanding about what it means to live next to a public space. And it's impossible to make a public space truly public if the public doesn't know they can go there.

In the long run, the Coastal Commission has a lot of work to do trying to create new access points and obtain further easements to satisfy the state's constitutional protection of the public coastline. But an app, in the meantime, could go no small way toward undoing the misconception that this beach isn't public in the first place.

As for these homeowners? "We're not quite sure what to expect, but I've never seen them not respond," Price says. "My great hope would be that everybody leaves us alone. But that hasn't been my experience in the past."

Top image, by Jenny Price, of Malibu Road Beach.

Keywords: Los Angeles, Homeowners, coast, Environment, beach, Water



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[?]

Conflict? What Conflict?

San Francisco Chronicle

By Matier & Ross

June 1, 2013 3:53 PM

Power player: When it comes to inside plays on the Golden State Warriors arena deal, super-lobbyist **Darius Anderson** and his associates at Platinum Advisors are playing both sides of the court.

And from the looks of things, scoring at every turn.

Anderson's lobbying firm not only represents the basketball team in its efforts to build a 17,500-seat waterfront arena in San Francisco, it's also representing Alameda County, which is fighting to keep the team in Oakland.

Nobody said anything about this rather odd arrangement until a couple of weeks back, when Berkeley Mayor **Tom Bates** - whose wife, **Loni Hancock**, is a state senator - told Alameda County Supervisor **Keith Carson** that Platinum was working hard in Sacramento to clear away barriers to the arena.

A bit awkward, considering that Alameda County taxpayers are shelling out \$320,000 a year for Platinum to represent their interests as well - including at Oracle Arena.

None of the parties would talk about the situation publicly, but from what we've been able to piece together, the solution is almost as interesting as the conflict.

Platinum will no longer represent the Warriors in Sacramento. It will, however, continue to represent the team in its dealings on the arena with San Francisco - which, coincidentally, is also a former Platinum client.

And for added fun, Platinum's Anderson is now involved with the Sacramento Kings' deal to build a new arena in that city as well.

Matier and Ross: San Francisco Chronicle, 6/27/13

Full-court press: The Golden State Warriors just pulled off quite a first-quarter play in their quest for a new San Francisco waterfront arena.

Thanks to an assist from Mayor **Ed Lee** and big labor, the team was able to block a potentially embarrassing vote before the Bay Conservation and Development Commission, which oversees the waterfront.

At issue: the team's attempt in the state Legislature to change the rules requiring commission approval for the project.

The commission's staff opposes the bill, as do many of the 29 commissioners themselves.

But when it came time the other day for the commission to go on record with a vote opposing the legislation, the Warriors' allies swung into action.

The one-on-one lobbying from Lee and local labor leaders helped flip the score in the team's favor.

"They were definitely working the bill," said Berkeley Mayor **Tom Bates**, husband of state Sen. **Loni Hancock** and one of the commission members who got an earful from labor about the project's benefits.

Contra Costa County Supervisor **John Gioia**, who also serves on the commission, got phone calls from both Lee and California Labor Federation officials.

Dozens of union types - from laborers and operating engineers to firefighters - also packed Thursday's commission hearing at the MetroCenter in downtown Oakland. It worked.

Instead of opposing the Sacramento play, the commission agreed to simply send a letter to legislators expressing their concerns about the attempted end run - and give the Warriors another month to try to work out their differences over the arena project with the commission's staff.

San Francisco Chronicle columnists Phillip Matier and Andrew Ross appear Sundays, Mondays and Wednesdays. Matier can be seen on the KPIX-TV morning and evening news. He can also be heard on KCBS radio Monday through Friday at 7:50 a.m. and 5:50 p.m. Got a tip? Call (415) 777-8815, or e-mail matierandross@sfnchronicle.com.

As Need for New Flood Maps Rises, Congress and Obama Cut Funding

by Theodoric Meyer ProPublica, May 24, 2013, 1:04 p.m.

As the United States grows warmer and extreme weather more common, the federal government's flood insurance maps are becoming increasingly important.

The maps, drawn by the Federal Emergency Management Agency, dictate the monthly premiums millions of American households pay for flood insurance. They are also designed to give homeowners and buyers the latest understanding of how likely their communities are to flood.

The government's response to the rising need for accurate maps? It's slashed funding for them.

Congress has cut funding for updating flood maps by more than half since 2010, from \$221 million down to \$100 million this year. And the president's latest budget request would slash funding for mapping even further to \$84 million — a drop of 62 percent over the last four years.

In a little-noticed written response to questions from a congressional hearing, FEMA estimated the cuts would delay its map program by three to five years. The program "will continue to make progress, but more homeowners will rely on flood hazard maps that are not current," FEMA wrote.

The cuts have slowed efforts to update flood maps across the country.

In New England, for instance, FEMA is updating coastal maps but has put off updating many flood maps along the region's rivers, said Kerry Bogdan, a senior engineer with FEMA's floodplain mapping program in Boston.

"Unfortunately, without the money to do it, we're limited and our hands are kind of tied," she said.

Many of the flood maps in Vermont — including areas near Lake Champlain that have recently flooded — are decades out of date. "There are definitely communities that really need that data," said Ned Swanberg, the flood hazard mapping coordinator with Vermont's Department of Environmental Conservation.

Asked about the cuts, a spokesman for the White House's Office of Management of Budget directed to us FEMA, which did not respond to our requests for comment.

New maps can guide development toward areas that are less likely to flood. They also tend to be far more accurate. Today's mapmakers can take advantage of technologies including lidar, or laser radar, and ADCIRC, a computer program that's used to model hurricane storm surge. They can also incorporate more years of flooding data into their models.

"It is disconcerting to have counties and areas where people still have maps from the 1970s," said Suzanne Jiwani, a floodplain mapping engineer with Minnesota's Department of Natural Resources.

The slashed funding for the mapping program hasn't gone unnoticed in Congress.

Rep. David E. Price, a North Carolina Democrat on the House Appropriations subcommittee that is responsible for FEMA's budget, told W. Craig Fugate, the FEMA administrator, at a hearing in March 2012 that FEMA's budget "continues to lowball funding" for updating the country's flood maps.

"Both Republican and Democratic Administrations have generally made inadequate requests for Flood Hazard Mapping and Risk Analysis funding, and under the Republican majority funding provided has been inadequate," Price said in a statement to ProPublica.

Andrew High, a spokesman for Price, said the congressman had pushed for modest boost in funding, about \$10 million this year.

It was a question from Price that prompted FEMA to detail the delays. FEMA said its ultimate goal was to get 80 percent of the country's flood hazard data up-to-date. Cutting funding for the program "is a difficult decision," FEMA wrote, "but it's reasonable given multitude of competing national priorities and limited resources."

FEMA also funds its maps through the National Flood Insurance Program. It takes a small slice of homeowners' flood insurance premiums, about \$150 million in the 2013 fiscal year. But the flood insurance program is also in trouble, and income from the premiums is already stretched thin. The program has more than \$20 billion in debt after paying out massive claims after Katrina and Sandy, and it took in only \$3.6 billion in premiums last year.

As part of an overhaul to the insurance program last year, Congress authorized the government to spend \$400 million a year for the next five years to update flood maps. But for the 2013 fiscal year, Congress has appropriated just a quarter of that. Sequestration has cut another \$5 million, according to the Office of Management and Budget, leaving \$95 million for flood mapping this year.

That's not nearly enough, said Larry Larson, director emeritus of the Association of State Floodplain Managers, a trade organization based in Madison, Wis.

"To get the mapping done, you need probably \$400 million a year for 10 years," Larson said.

The experiences of some homeowners after Sandy illustrate the dangers of outdated flood maps.

FEMA was in the process of updating the maps in New York City and New Jersey when Sandy hit. After the storm, the agency rushed to complete "advisory" flood maps designed to give homeowners a rough idea of how much they might need to raise their damaged homes by to avoid catastrophically high flood insurance premiums — more than \$30,000 a year for some homeowners in the worst flood zones.


But homeowners like George Kasimos, whose Toms River, N.J., house was damaged in the storm, say they don't want to shell out tens of thousands of dollars to raise their homes until FEMA has finalized the new maps. FEMA plans to release preliminary maps for New Jersey this summer, but the final ones aren't expected until late next year. (Scott Duell, the risk analysis chief for FEMA in New York, said that the cuts had not slowed down work on the new maps in New York and New Jersey.)

Kasimos said any cuts to the flood mapping program were shortsighted.

"There's going to be another hurricane somewhere, there's going to be another disaster," he said. "If you're cutting the flood mapping program, somebody's going to get screwed."

STORM OF THE CENTURY EVERY TWO YEARS

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(American Accent )

Section:

CLIMATE SCIENCE

New York City and the entire U.S. East Coast could face frequent destruction unless the region takes drastic action

THOMAS ABDALLAH HAS SEEN A LOT OF WATER in his 26 **years** of work for New York City's transit system. In December 1992 a nor'easter **storm** killed the subway's power, forcing rescue crews to evacuate passengers from flooding tunnels. In August 2007 a five-inch deluge that

meteorologists called an "extreme climate event" shut down the system again. So did Hurricane Irene in August 2011. Then came Hurricane Sandy.

As Sandy's **storm** surge began to flood downtown Manhattan last October, dozens of New York City transit workers scrambled in the wind and rain to place plywood sheets and sandbags across subway entrances. But the oncoming water pushed right through the feeble barricades, pouring down stairwells until underground stations filled chest deep, in turn filling seven long train tunnels running under the rivers between the boroughs. Huge pumps in more than 300 man-made caverns deep below the city's subway line, which can push out 18 million gallons of water a day, couldn't possibly keep up.

After the deluge, Abdallah, who is the transit system's chief environmental engineer, assessed the damage with his colleagues. Saltwater had corroded electrical equipment throughout the subway system. Much of it had to be replaced. The transit authority chair at the time, Joe Lhota (now running for mayor), testified before Congress that fully restoring the system would cost \$5 billion. And that would just bring the subways back to their pre-Sandy condition; the money would do nothing to enhance protection against the next hurricane or against rising seas.

That status quo is becoming increasingly costly in money and lives. Experts predict that damaging **storms** will get more severe and more frequent. According to the latest estimates, the chance of widely destructive flooding in New York City will be one in **two** each **year** by the end of the **century** unless significant infrastructure changes are made. Each decade from now until then, the "average" flood will become worse and worse. Billions of dollars in repairs will become commonplace.

New York City is not alone in facing a watery future. The U.S. East Coast -- one of the wealthiest and most densely populated regions in the world -- is a hotspot for sea-level rise. Melting Arctic ice is changing Atlantic Ocean currents in a way that raises water along the coast. At the same time, the land is subsiding. In 2012 Asbury Sallenger of the U.S. Geological Survey reported that for the prior 60 **years**, sea level from Cape Cod outside Boston to Cape Hatteras in North Carolina had risen three to four times faster than the global average. Using the data, Sallenger (who died in February) confirmed models by colleagues indicating that by 2100 the mid-Atlantic region would experience 4.7 to 9.4 inches of sea-level rise above and beyond the average global increase, which itself is expected to be several feet at least.

Sandy's damage has focused the minds of scientists, politicians and the public on the vulnerability of coastal areas to **storm** surges and sea-level rise. Experts are debating which actions could best protect the Eastern seaboard, especially as millions more people flock there. Turning the entire coastline into a fortress is prohibitively expensive and would ultimately be a losing proposition for many sandy coastlines. Yet the alternative -- moving people away from the water -- would be a

political tinderbox and cause social and economic disruption.

This dilemma is being played out in New York City, where scientists and engineers are scrambling to present protection options to Mayor Michael R. Bloomberg by the end of May. They were expected to recommend steps to repel minor flooding, but it is not clear that they would be willing to recommend the only sure way to protect against an 11-foot surge like Sandy's: massive flood barriers that would cost \$10 billion to \$20 billion. It is also unclear whether they would recommend an end to federal subsidies for flood insurance and the evacuation of low-lying land, even though these steps are the ultimate long-term solutions to the sea-level rise that the latest climate science predicts.

The choices are even more stark for the long stretches of coastlines between cities -- along New Jersey, Maryland, the Carolinas, Florida. The U.S. would have to build a wall 16 feet high -- to handle **storm** surge on top of sea-level rise -- along **every** inch of the East Coast. Even if the money for such work were found, the millions of people who live in beachside communities would never stand for it because it would block their ocean view and access. The only politically viable option is to continually pile sand along beaches, even though higher and higher seas will erode more and more of it away -- a Sisyphean postponing of the inevitable retreat from the shore.

In interviews with dozens of experts, it is clear that extreme measures needed to harden the East Coast would take decades to complete, cost hundreds of billions of dollars and disrupt many lives, but they are necessary evils.

DEFENDING NEW YORK CITY

SINCE HURRICANE SANDY struck, all eyes have turned toward New York City to see how best to defend against rising water. The metropolis ranks in the top 10 port cities most exposed to flooding worldwide and has more than \$2 trillion of coastal property at risk -- first or second on the planet. When Cynthia Rosenzweig, a climate scientist at Columbia University, attended a global environment meeting after Sandy occurred, city officials from around the world told her they were looking to New York to lead.

Scientists and engineers are scrambling because Sandy and new science have washed out the basic assumptions that the city had made. In 2009 a report by the New York City Panel on Climate Change (NPCC) stated that the city should plan for at least **two** feet of sea-level rise by 2100, based on conventional climate models. But in 2012 new information from various global sources showed that Antarctica and Greenland are melting quicker than models predicted. According to what scientists call the rapid ice-melt scenario, global sea level will rise four feet by the 2080s, notes Klaus Jacob, a research scientist at Columbia's Lamont-Doherty Earth Observatory. In New York City, by 2100 "it will be five feet, plus or minus one foot," Jacob says flatly.

The NPCC report also did not focus much on **storm** surges. Sandy's surge topped out at about 11 feet above average sea level at the lower tip of Manhattan. But here's the rub: Flood maps just updated in January by the Federal Emergency Management Agency indicate that an eight-foot surge would cause widespread, destructive flooding. So if sea level rises by five feet by 2100, a surge of only three feet is needed to inflict considerable damage.

Of course, rapid climate change would push the sea higher **every** decade until then. Jacob says the chance of what had been a one-in-100-year **storm** surge occurring in New York City will be one in 50 during any **year** in the 2020s, one in 15 during the 2050s and one in **two** by the 2080s. Scientists at the Massachusetts Institute of Technology say the chance of a one-in-100-year **storm** will be as great as one in three by 2100.

Despite the dire odds, none of the more than 20 scientists, engineers and city officials interviewed for this article would articulate a grand plan for protecting New York City against five feet of sea-level rise, plus an 11-foot surge, because that would require politically difficult choices. The lone exception is Jeroen Aerts, who served as an adviser to New York City's Office of Long-Term Planning and Sustainability and Department of City Planning, until they parted ways after Hurricane Sandy.

To Aerts, the necessary plan is straightforward. Immediately start flood-proofing buildings, which would harden them against events like the five-inch deluge in 2007. Begin to retrofit subway, train and automobile tunnels so water cannot get in. Armor power plants, wastewater treatment facilities and other "critical infrastructure." Meanwhile start the process of changing zoning laws to discourage construction in the lowest-lying areas. Add seawalls along the low edges of the city's boroughs to fend off rising sea level. And start doing environmental and cost-benefit studies for enormous barriers that would be dropped into the bay to hold back surges. Those studies take **years**, and construction would take **years** more, "so it will be 2030 before barriers would be in place," Aerts explains. "In the meantime, you start implementing the 'no regret' steps," such as raising subway entrances so flood-water cannot pour down the stairways onto the tracks.

Aerts was hoping New York would impose a regional plan such as the one he was developing, but in the aftermath of Sandy the groups he was advising told him that regional politics would make a centrally executed plan impossible. That is a far cry from how things work where Aerts comes from: he is a specialist in geographical risk management at the Institute for Environmental Studies in Amsterdam. In the Netherlands, top-down management is a key to building and maintaining the world's most extensive flood-protection system. When Aerts realized that New York City's politics precluded such an approach, he and the city agreed to work separately. He continues to develop his blueprint, aiming for the end of May, parallel to the NPCC's deadline for reporting to Bloomberg. He is concerned that planners may shrink from recommending expensive barriers in a time of tight

budgets and from recommending retreat from the shore.

Even if state and local governments were to accept Aerts's plan, it has its complications. For one thing, engineers would still have to agree on the best places to install the massive structures. A barrier is basically a wall that has enormous gates within it. The gates normally stay open to allow ships to pass and to allow the daily mixing of tides and freshwater from rivers that keeps a bay's ecosystem alive. When a **storm** comes, the gates close to hold back the surge.

Malcolm Bowman of Stony Brook University floated a plan several **years** ago for three barriers that would primarily protect Manhattan, but engineers are now leaning toward a **two**-barrier plan proposed by the commercial Halcrow Group that includes a five-mile-long span that would close off all of New York City [see box on page 63]. Although such a mammoth "outer harbor gateway" might sound crazy, in 2010 a barrier three times longer began operating in St. Petersburg, Russia. That \$6.9-billion barrier is a good model because the water depths and land elevations in St. Petersburg are similar to those in New York City, says Jonathan Goldstick, an engineer and vice president at Halcrow, a lead consultant for the St. Petersburg installation.

Because gates remain open, barriers do nothing to deflect sea-level rise, so other measures would be needed for that threat. Critics also contend the water that a barrier holds back would flow to either side, making flooding worse in adjacent communities. But Philip Orton, an ocean engineer at Stevens Institute of Technology, says most of the reflected water spreads out across the sea. Before Sandy struck, he and his colleagues were running a computer model that re-creates the **storm** surge from Cape Cod to Maryland from Hurricane Irene. Orton can simulate barriers in different places to see how the surge responds. Tests of Bowman's three-barrier system showed that water alongside the gates would rise only an additional 5 to 7 percent. Orton is now adapting the model to Sandy's floodwaters.

Another concern is that barriers can become death traps. That's why Jacob is not a fan, even though they would have prevented Sandy from flooding his own house up the Hudson River from Manhattan. As barriers close off the bay around the city, the massive Hudson River, other rivers and heavy rainfall flowing into New York Bay would begin to fill it from behind the closed wall. Orton says the rate could be as high as three feet a day -- but that is a lesser evil than an 11-foot surge. Most surges last only a matter of hours, so procedures would have to be in place to reopen the gates as soon as possible.

Huge barriers have proved effective in several places around the world. But one lesson the Dutch learned the hard way would have to be incorporated into any New York plan. They started building barriers in the 1950s and recently began to reengineer them at great cost to account for sea-level rise. New York would have to design barriers that can be raised over time -- five feet in the ensuing

90 years, then more in the next **century**.

Likewise, new building codes to direct flood-proofing measures would have to take into account ongoing sea-level rise. Any adaptation plan should be even broader than that, says Sergej Mahnovski, director of the city's Office of Long-Term Planning and Sustainability. It should address all aspects of climate change, including longer heat waves and higher humidity that could seriously stress the electric grid, as well as stronger winds.

The main objection to barriers is cost. Yet the investment could pay off handsomely. Paul Kirshen, professor of environmental research and engineering at the University of New Hampshire, says **every** \$1 spent in protection measures can prevent \$4 in repairs after a **storm**, based on smaller-scale measures already implemented in various Northeast municipalities. Sandy cost New York City \$19 billion in losses, according to Bloomberg. That's just one **storm**.

Each city will have to assess its own unique threats and potential solutions. Because sea level in Norfolk, Va., the third-largest port on the East Coast, has risen 14 inches since the 1930s, its downtown area floods often. Miami might face the worst case. It is exposed to many more hurricanes than the Northeast, and unlike New York City almost all of it is at sea level. Moreover, the city is built on porous carbonate. When the sea lifts, the carbonate absorbs water, which rises up through the streets, flooding the city from the inside out. "How do you defend against that?" asks S. Jeffress Williams, a coastal marine geologist at the U.S. Geological Survey and the University of Hawaii. "I don't know." The city is expanding a pumping system that clears floodwater from rainstorms, but the system cannot pump the city out of a surge and would be useless for five feet of sea-level rise because the elevation of much of Miami is less than three feet.

PROTECTING THE EAST COAST

BARRIERS AND SEAWALLS might protect certain cities, but what can be done for the hundreds of miles of Jersey, Carolina or Florida beachfronts between them? Conventional measures such as man-made wetlands are inadequate. Wetlands that can absorb minor surges do not grow well along sloped shorelines exposed to open seas -- and they offer no protection against sea-level rise. Swimming in muck doesn't thrill anyone, either. Piling up sand as an endless dune or a deep, rising beach is the only engineering option; however, "it's not clear there is enough quality sand" out on the continental shelf, Williams says.

Sand that has the right grain size to hold a beach against waves, much less **storms**, occurs in discrete deposits on the ocean floor, built up over thousands of **years**. Ships pump the sand onto barges, which drop it on the shore, where workers spread it with trucks. This "beach nourishment" requires vast quantities of sand and money, and it's a losing game. As routine tides and **storms** relentlessly wash away beach sand, it fans out across the seafloor in thin layers that cannot be

harvested.

Over time a higher ocean will wash away even more sand. "Could beach nourishment keep up with sea-level rise and surge for a few decades? Probably," says Robert Young, a geologist at Western Carolina University and an expert in beach nourishment. "Could we do it for 100 **years**? I don't think so."

For now, the U.S. Army Corps of Engineers, which mines and bulldozes much of the sand in question, will continue to replenish beaches **every** five to 10 **years**, according to Kathleen White, a senior environmental engineer there. Each episode can cost \$1.5 million to \$10 million per mile; New Jersey is at the high end. White says the corps is looking across a larger span of ocean for quality deposits, but she cannot say what it might find. Of course, the farther from shore the sand is, the more it costs to retrieve.

The entire pursuit is dubious in the long term, however. Beaches and barrier islands -- which are wearing thin along the East Coast -- are meant to slowly migrate landward, as very high tides or surges push sand from the ocean side toward the land side. The migration allows the beachfront to remain high and robust -- nature's own **storm** protection. "The only reason for beach nourishment is to keep a beach line in place," Young says. The best way to preserve a beachfront is to let it move. Protective seawalls make matters worse over time. They stop the sand from migrating and reflect wave energy, so it scours away even more sand. "Erosion doesn't destroy beaches," Young says. "Seawalls and roads do, by getting in the way of natural beach relocation."

END THE PERVERSION

ALLOWING MIGRATION means people along the shore have to get out of the way. But perverse incentives encourage them to remain in high-risk areas.

Disaster recovery funds are one culprit. As long as Congress keeps authorizing them, people will keep rebuilding. The National Flood Insurance Program is another because the federal government subsidizes it. Individuals and businesses in flood zones do not pay anywhere near the full premiums. If they did, Aerts notes, "people would say, 'Oh, that is too high,' and they wouldn't build there."

Federal subsidies create "a moral hazard," Young maintains. "It's a totally false economy. It's bad fiscal policy, and it's bad federal policy -- if we believe we should be adapting to climate change. I'm not suggesting we abandon the coast," he adds. "But it has to pay for itself."

After decades, Congress has just begun to change the program. Less subsidized premiums will be slowly phased in. A homeowner at the highest point in a floodplain might pay \$800 a **year**, for

example, but someone near the lowest point might pay \$25,000. Gradually, people might opt to abandon the most expensive -- and vulnerable -- land.

It is still unclear if flood insurance subsidies will disappear entirely, and wealthy people could still choose to build in low-lying areas at their own financial risk, forcing municipalities to try to provide some form of public safety during **storms**. As an alternative, cities and states could buy out residents whose properties repeatedly flood. New York governor Andrew Cuomo said he would use \$400 million of his state's federal disaster relief to offer such buyouts. Cas Holloway, deputy mayor for operations in New York City, says Sandy ruined about 500 homes there, and another 500 might have to be demolished.

If done over, say, 50 **years**, buyouts could clear the most vulnerable neighborhoods, leaving the land as a natural buffer.

RETREAT OR SWIM

BUYOUTS EPITOMIZE the ultimate solution to **storm** protection: retreat from the shore. But retreat is a tough sell. When Kirshen surveyed people who live in the low-lying East Boston community, they uniformly said they would not leave, even after recurrent flooding. They said the ocean is part of their identity. Rosenzweig, the Columbia climate scientist (who co-chairs the NPCC), adds that no adaptation plan can succeed "without taking the voices of neighborhoods into account."

Moving people is also politically unpopular. "Are we thinking about categorical retreat from the sea?" asks New York City deputy mayor Holloway rhetorically. "Absolutely not."

Yet retreat is under way elsewhere. The people and houses of Billingsgate Island off Cape Cod and of Hog Island off Virginia were moved to the mainland long ago. After a March 7 nor'easter ruined more than a dozen homes on Plum Island north of Boston, Massachusetts officials reiterated the state's policy of not allowing seawalls, saying that in the lowest-lying areas, moving homes to higher ground is the best option.

Jacob thinks that retreat is unavoidable and that discounting it is a form of risk denial. Policies need to be put in place to encourage people to move, he says. The Nature Conservancy, for example, is encouraging New York and other states to establish land trusts that can buy out a community, help it relocate, and allow the land to become a park or revert to a natural landscape.

The U.S.'s census of New York City, however, shows that even more people were living in low-lying areas in 2010 than in 2000. That trend is particularly befuddling, Jacob notes, because unlike Miami, much of New York City does lie well above sea level. With grim irony, he points out that "the city has a lot of cemeteries on high ground. We could switch the living and the dead, and probably

the dead wouldn't mind." To him, that morbid plan might be a lesser evil than beachside residents drowning in a future **storm**.

Do leaders of cities and suburbs all along the coastal U.S. have the political will to do what's right for the long term? Or will they postpone the tough decisions and let nature force the consequences on residents later, at considerably more expense and suffering? SA

MORE TO EXPLORE

NY-NJ Outer Harbor Gateway. Presentation by Dennis V. Padron and Graeme Forsyth.

March 31, 2009. Available as a PDF at <http://bit.ly/XHwUSJ>

Climate Change Adaptation in New York City: Building a Risk Management Response. New York City Panel on Climate Change in Annals of the New York Academy of Sciences, Vol. 1196; May 2010.

Hotspot of Accelerated Sea-Level Rise on the Atlantic Coast of North America.

Asbury H. Sallenger, Jr., et al. in Nature Climate Change, Vol. 2, pages 884-888; December 2012.

SCIENTIFIC AMERICAN ONLINE

For a full explanation of why sea level could rise by five feet in New York City by 2100, see ScientificAmerican.com/jun2013/fischetti

IN BRIEF

The chances of severe flooding in New York City will be as high as one in **two** each **year** by 2100, in part because the U.S. East Coast is a hotspot for sea-level rise.

Experts may be reluctant to recommend the ultimate protection measures for New York City: building massive barriers that would cost billions of dollars and moving communities out of the lowest-lying areas.

The primary way to protect long coastlines between cities is to pile sand along beaches **every** five to 10 **years**, but it is unclear whether enough quality sand deposits exist offshore.

Ending federal subsidies for flood insurance, so that beachfront residents must pay the full cost, might encourage people to move out of vulnerable areas.

EAST COAST

Sea-Level Rise: A Global Hotspot

Rising seas could drown a significant portion of the U.S.'s valuable and highly populated East Coast, including famous cities. The latest estimates indicate that global sea level could rise by at least one meter (3.3 feet) by 2080 (red), as warmer seas expand and glaciers melt. Yet the effect is not uniform around the world. The coast from Massachusetts to North Carolina is a hotspot; sea level there has risen three to four times faster than the global average over the past 40 **years**, in part because of changes in Atlantic Ocean currents caused by melting ice in the Arctic (map at far right). Furthermore, the land under most of the coast is sinking, making the sea relatively higher still (green line). Certain municipalities such as Atlantic City are subsiding even faster because they are rapidly extracting groundwater that helps to prop up land.

NEW YORK CITY

Storm Surge: Block It or Abandon Shore

Storm surge and sea-level rise threaten New York City. Hurricane Sandy's 3.4-meter (11-foot) surge was the highest to hit the city's metropolitan area. Like most cities, New York bases protection plans on maps from the Federal Emergency Management Agency, which show where flooding most likely will occur if a one-in-100-year **storm** hits. FEMA updated New York's flood zones in January, but Sandy's surge flowed farther inland in many areas (key below). **Two** massive barriers could hold back surges, but residents might have to abandon the lowest-lying communities, which already flood regularly, as seas relentlessly rise.

LOWER MANHATTAN

Flood Damage: Local Fixes Can Lessen Loss

As seas rise, tides and surges will invade farther into a coastal city, and even routine **storms** will cause more extensive flooding. Many street-level protection measures have been proposed for New York City and other municipalities; a variety of these proposals are shown here. Although quick implementation is tempting, experts warn that any mitigation measure should first meet standards and policies established in a region-wide protection plan, including a cost-benefit analysis for the short and long term. Otherwise, money could be wasted.

MAP: Sea-Level Rise: A Global Hotspot

MAP: **Storm** Surge: Block It or Abandon Shore

MAP: Flood Damage: Local Fixes Can Lessen Loss

PHOTO (COLOR): HOBOKEN, N.J.: Sandy's **storm** surge flooded downtown and cut off power.

PHOTO (COLOR): STATEN ISLAND: At least 17 residents drowned despite protective levees.

PHOTO (COLOR): MANHATTAN: Superstorm Sandy engulfed streets and filled subway tunnels.

PHOTO (COLOR): BROOKLYN: Raging water ruined buildings and sparked devastating fires.

PHOTO (COLOR)

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By Mark Fischetti

Maps by XNR Productions

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